MontCAS

Mathematics

Item Specifications
Grades 3-8 and 10

Grade 3

Mathematics Content Standard 1

Students engage in the mathematical process of problem solving and reasoning, estimation, communication, connections and applications, and using appropriate technology.

Benchmark End of Grade 4	GLCE Grade 3	Item Specification Grade 3
1. Solves problems from many contexts using a variety of strategies (e.g., estimate, make a table, look for a pattern, and simplify the problem). Explain the methods for solving these problems.	1. Selects and uses appropriate problem-solving strategies (e.g., estimate, look for a pattern, simplify the problem) and technologies (e.g., paper and pencil, calculator) in many contexts. **3.1.1.1** **3.1.2.1** **3.1.3.1** **3.1.4.1** **3.1.5.1** 2. Communicates solutions to problems in a variety of ways (e.g., concrete, pictorial, graphical). **3.1.1.2** **3.1.2.2** **3.1.3.2** **3.1.4.2** **3.1.5.2**	Standard 1 is embedded throughout the Benchmarks and GLCEs to emphasize the importance of the mathematical processes of problem solving and reasoning, estimation, communication, connections and applications, and using appropriate technology as part of every strand.
2. Applies estimation strategies throughout the problem-solving process.		
3. Communicates mathematical ideas in a variety of ways (e.g., written, verbal, concrete, pictorial, graphical, algebraic).		
4. Recognizes and investigates the relevance and usefulness of mathematics through applications, both in and out of school.		
5. Selects and uses appropriate technology to enhance mathematical understanding. Appropriate technology may include, but is not limited to, paper and pencil, calculator, and computer.		

Grade 3

Mathematics Content Standard 2

Students demonstrate understanding of and an ability to use numbers and operations.

Benchmark End of Grade 4	GLCE Grade 3	Item Specification Grade 3
1. Exhibits connections between the concrete and symbolic representations of a problem or concept.	3. Uses addition, subtraction, and multiplication of whole numbers to estimate, compute, and determine whether results are accurate.	1. Relates multiplication and division to pictorial models of the operations. **3.2.1.3.1** 2. Relates addition, subtraction, multiplication, and division to real-life situations appropriate to those operations. **3.2.1.3.2**
2. Uses the number system by counting, grouping and applying place value concepts.		3. Reads and writes whole numbers to 9999. **3.2.2.3.3** 4. Recognizes place value in whole numbers to 9999. **3.2.2.3.4** 5. Identifies the ordinal position (first, second, third, etc.) of objects or events. **3.2.2.3.5** 6. Orders whole numbers to 9999 with and without the use of inequality symbols and number lines. **3.2.2.3.6** 7. Recognizes and generates equivalent expressions of whole numbers (composing and decomposing whole numbers). **3.2.2.3.7** 8. Recognizes odd and even numbers and numbers found by skip counting by 2, 3, 4, 5, and 10. **3.2.2.3.8**
3. Models, explains, and uses basic facts, the operations of addition and subtraction of whole numbers, and mental mathematics.		9. Adds and subtracts whole numbers and money. **3.2.3.3.9** 10. Estimates based on addition and subtraction. **3.2.3.3.10** 11. Solves simple, two-step story problems by adding and subtracting. **3.2.3.3.11**
4. Models and explains multiplication and division of whole numbers.		12. Multiplies and divides whole numbers involving the basic facts only. **3.2.4.3.12** 13. Estimates based on multiplication and division. **3.2.4.3.13** 14. Solves simple, two-step story problems by multiplying and dividing. **3.2.4.3.14**
5. Models and explains part/whole relationships in everyday situations.		15. Relates fractions with denominators of 2, 3, 4, 5, or 10 to region and set models. **3.2.5.3.15** 16. Relates decimal notation to tenths to region models. **3.2.5.3.16** 17. Recognizes equivalent fractions and

		decimals when presented with models. **3.2.5.3.17**

Grade 3

Mathematics Content Standard 3

Students use algebraic concepts, processes, and language to model and solve a variety of real-world and mathematical problems.

Benchmark End of Grade 4	GLCE Grade 3	Item Specification Grade 3
1. Uses symbols (e.g., boxes or letters) to represent numbers in simple situations.	4. Selects and solves number sentences (with boxes or letters) that represent simple real-world addition or subtraction situations.	1. Represents appropriate, real-life situations with addition or subtraction open sentences. **3.3.1.4.1**
2. Explores the use of variables and open sentences to express relationships (e.g., missing addend).		2. Identifies the missing number, represented by a box or other symbol, in an addition or subtraction open sentence. **3.3.2.4.2**
3. Uses inverse operations and other strategies to solve number sentences.		3. Recognizes the relationships among the four operations on whole numbers. **3.3.3.4.3** 4. Applies the commutative, associative, and identity properties. **3.3.3.4.4**

Grade 3

Mathematics Content Standard 4

Students demonstrate understanding of shape and an ability to use geometry.

Benchmark End of Grade 4	**GLCE Grade 3**	**Item Specification Grade 3**
1. Describes, models, and classifies two- and three-dimensional shapes.	5. Identifies two- and three-dimensional shapes.	1. Uses properties to describe, identify, and sort two- and three-dimensional figures. **3.4.1.5.1** 2. Recognizes two- and three-dimensional figures irrespective of their orientation. **3.4.1.5.2**
2. Investigates and predicts results of combining, subdividing, and changing shapes.		3. Recognizes the results of subdividing and combining shapes. **3.4.2.5.3** 4. Visualizes the effect of procedures such as cutting a figure from a folded piece of paper. **3.4.2.5.4**
3. Identifies lines of symmetry, congruent and similar shapes, and positional relationships.		5. Recognizes figures that have the same size and shape (congruent figures). **3.4.3.5.5** 6. Identifies a symmetric figure and its line of symmetry. **3.4.3.5.6** 7. Describes motion involving distance and direction (left, right, up, down) on a grid. **3.4.3.5.7**

Grade 3

Mathematics Content Standard 5

Students demonstrate understanding of measurable attributes and an ability to use measurement processes.

Benchmark **End of Grade 4**	**GLCE Grade 3**	**Item Specification Grade 3**
1. Estimates, measures, and investigates length, capacity, weight, mass, area, volume, time and temperature.	6. Identifies measurable attributes of objects (e.g., length, time), and selects and uses appropriate tools to measure them.	1. Makes reasonable estimates of length, capacity, weight, or temperature for a given object or situation. **3.5.1.6.1** 2. Uses rulers to measure lengths to the nearest inch or centimeter. **3.5.1.6.2** 3. Tells time to the nearest minute, using analog and digital clocks. **3.5.1.6.3** 4. Uses a calendar to determine days of the week, dates, and lapsed time. **3.5.1.6.4** 5. Reads a pictured thermometer or scale with accuracy to the labeled numbers. **3.5.1.6.5** 6. Finds the distance around (perimeter) or area of a region made of congruent squares. **3.5.1.6.6**
2. Develops the process of measuring and concepts related to units of measurement, including standard units (English and metric) and nonstandard units.		7. Orders objects relative to size of a measurable attribute. **3.5.2.6.7** 8. Performs simple conversions that can be easily performed using addition between the following: inches and feet, cups and pints, pints and quarts, ounces and pounds, minutes and hours, days and weeks. **3.5.2.6.8**
3. Applies measurement skills to everyday situations.		9. Determines the value of a set of pictured coins worth less than one dollar. **3.5.3.6.9**
4. Selects and uses appropriate tools and techniques.		10. Selects the best tool to use to measure length, capacity, weight/mass, or temperature of given object. **3.5.4.6.10** 11. Selects the best unit to use for a length, capacity, or weight/mass measurement. **3.5.4.6.11**

Grade 3

Mathematics Content Standard 6

Students demonstrate understanding of and an ability to use data analysis, probability, and statistics.

Benchmark End of Grade 4	**GLCE Grade 3**	**Item Specification Grade 3**
1. Collects, organizes, and displays data.	7. Draws appropriate conclusions (makes interpretations) using data.	1. Selects questions to be asked and groups to be surveyed for a given purpose. **3.6.1.7.1**
2. Constructs, reads, and interprets displays of data, including graphs.		2. Reads data from a chart or bar graph. **3.6.2.7.2** 3. Records data on a bar graph. **3.6.2.7.3**
3. Formulates and solves problems that involve collecting and analyzing data.		4. Recognizes the most common data point in a set of data (mode). **3.6.3.7.4** 5**.** Draws simple conclusions based on data given in charts or bar graphs. **3.6.3.7.5**
4. Demonstrates basic concepts of chance (e.g., equally likely events, simple probabilities).		6. Judges events as impossible, very likely, unlikely, or certain. **3.6.4.7.6**

Grade 3

Mathematics Content Standard 7

Students demonstrate understanding of and an ability to use patterns, relations, and functions.

Benchmark **End of Grade 4**	**GLCE Grade 3**	**Item Specification Grade 3**
1. Recognizes, describes, extends, and creates a variety of patterns.	8. Identifies a variety of patterns and states the next term in the pattern.	1. Determines the next term(s) or missing term(s) in a numeric or geometric pattern. **3.7.1.8.1** 2. Represents rules for numeric patterns using words or symbols, e.g., "add 2" or "+4, –1." **3.7.1.8.2** 3. Creates patterns given a simple rule. **3.7.1.8.3**
2. Represents and describes mathematical and real-world relationships.		4. Matches a simple chart with a described real-life situation or a pattern. **3.7.2.8.4** 5. Matches a situation involving a constant rate of change to a bar graph that best represents that situation. **3.7.2.8.5**

Grade 4

Mathematics Content Standard 1

Students engage in the mathematical process of problem solving and reasoning, estimation, communication, connections and applications, and using appropriate technology.

Benchmark End of Grade 4	GLCE Grade 4	Item Specification Grade 4
1. Solves problems from many contexts using a variety of strategies (e.g., estimate, make a table, look for a pattern, and simplify the problem). Explain the methods for solving these problems.	1. Selects and uses appropriate problem-solving strategies (e.g., estimate, make a table, look for a pattern, simplify the problem) and technologies (e.g., paper and pencil, calculator, computer) in many contexts. **4.1.1.1** **4.1.2.1** **4.1.3.1** **4.1.4.1** **4.1.5.1** 2. Communicates solutions to problems in a variety of ways (e.g., written, verbal, concrete, pictorial, graphical, algebraic). **4.1.1.2** **4.1.2.2** **4.1.3.2** **4.1.4.2** **4.1.5.2**	Standard 1 is embedded throughout the Benchmarks and GLCEs to emphasize the importance of the mathematical processes of problem solving and reasoning, estimation, communication, connections and applications, and using appropriate technology as part of every strand.
2. Applies estimation strategies throughout the problem-solving process.		
3. Communicates mathematical ideas in a variety of ways (e.g., written, verbal, concrete, pictorial, graphical, algebraic).		
4. Recognizes and investigates the relevance and usefulness of mathematics through applications, both in and out of school.		
5. Selects and uses appropriate technology to enhance mathematical understanding. Appropriate technology may include, but is not limited to, paper and pencil, calculator, and computer.		

Grade 4

Mathematics Content Standard 2

Students demonstrate understanding of and an ability to use numbers and operations.

Benchmark End of Grade 4	GLCE Grade 4	Item Specification Grade 4
1. Exhibits connections between the concrete and symbolic representations of a problem or concept.	3. Uses addition, subtraction, multiplication, and division of whole numbers to estimate, compute, and determine whether results are accurate.	1. Relates multiplication and division to pictorial models of the operations. **4.2.1.3.1** 2. Relates addition, subtraction, multiplication, and division to real-life situations, including division situations requiring interpretation of a remainder. **4.2.1.3.2** 3. Creates story problems that can be solved using given number sentences or operations. **4.2.1.3.3**
2. Uses the number system by counting, grouping and applying place value concepts.		4. Reads and writes whole numbers to one million. **4.2.2.3.4** 5. Recognizes place value in whole numbers to one million. **4.2.2.3.5** 6. Rounds whole numbers to a specified place value position of ten thousand or less. **4.2.2.3.6** 7. Orders whole numbers to one million with and without the use of inequality symbols and number lines. **4.2.2.3.7** 8. Recognizes and generates equivalent expressions of whole numbers (composing and decomposing whole numbers). **4.2.2.3.8** 9. Recognizes odd and even numbers and numbers found by skip counting. **4.2.2.3.9**
3. Models, explains, and uses basic facts, the operations of addition and subtraction of whole numbers, and mental mathematics.		10. Adds and subtracts whole numbers and money. **4.2.3.3.10** 11. Estimates based on addition and subtraction. **4.2.3.3.11** 12. Solves two-step story problems. **4.2.3.3.12**
4. Models and explains multiplication and division of whole numbers.		13. Recognizes factors and multiples. **4.2.4.3.13** 14. Multiplies whole numbers and money not to exceed the product of a three-digit and a two-digit number. **4.2.4.3.14** 15. Divides whole numbers not to exceed the quotient of a four-digit number divided by a one-digit number. **4.2.4.3.15** 16. Estimates based on multiplication

		and division. **4.2.4.3.16** 17. Solves two-step story problems. **4.2.4.3.17**
5. Models and explains part/whole relationships in everyday situations.		18. Relates commonly used fractions to regions, sets, and number lines. **4.2.5.3.18** 19. Relates decimal notation (tenths and hundredths) to region and number line models and to place value. **4.2.5.3.19** 20. Recognizes equivalent fractions and equivalent decimals when presented with models. **4.2.5.3.20** 21. Orders fractions and decimals when presented with models. **4.2.5.3.21** 22. Adds simple fractions based on pictorial models. **4.2.5.3.22**

Grade 4

Mathematics Content Standard 3

Students use algebraic concepts, processes, and language to model and solve a variety of real-world and mathematical problems.

Benchmark End of Grade 4	GLCE Grade 4	Item Specification Grade 4
1. Uses symbols (e.g., boxes or letters) to represent numbers in simple situations.	4. Applies basic algebra concepts using concrete and symbolic representations (e.g., number sentences with boxes or letters) and communicates relationships in a variety of ways.	1. Represents real-life situations with addition, subtraction, multiplication, and division open sentences. **4.3.1.4.1**
2. Explores the use of variables and open sentences to express relationships (e.g., missing addend).		2. Identifies the missing number, represented by a box, symbol, or letter, in an addition, subtraction, multiplication, or division open sentence. **4.3.2.4.2** 3. Finds replacements for variables, represented by boxes, symbols, or letters, to make number sentences true. **4.3.2.4.3**
3. Uses inverse operations and other strategies to solve number sentences.		4. Recognizes the relationships among the four operations on whole numbers. **4.3.3.4.4** 5. Applies the commutative, associative, and identity properties, as well as recognizing the role of zero in multiplication. **4.3.3.4.5**

Grade 4

Mathematics Content Standard 4

Students demonstrate understanding of shape and an ability to use geometry.

Benchmark End of Grade 4	GLCE Grade 4	Item Specification Grade 4
1. Describes, models, and classifies two- and three-dimensional shapes.	5. Identifies two- and three-dimensional shapes and accurately uses relationships among shapes (e.g., combinations, subdivisions, symmetry, congruence, position) to solve problems in the physical world.	1. Uses properties to describe, identify, and sort two- and three-dimensional figures. **4.4.1.5.1** 2. Recognizes two- and three-dimensional figures irrespective of their orientation. **4.4.1.5.2**
2. Investigates and predicts results of combining, subdividing, and changing shapes.		3. Recognizes the results of subdividing and combining shapes. **4.4.2.5.3** 4. Visualizes the effect of procedures such as cutting a figure from a folded piece of paper. **4.4.2.5.4** 5. Identifies a net (pattern) of a simple three-dimensional figure such as a cube. **4.4.2.5.5** 6. Identifies views (e.g., front, top, right side) of a three-dimensional object or a structure built from cubes. **4.4.2.5.6**
3. Identifies lines of symmetry, congruent and similar shapes, and positional relationships.		7. Recognizes congruent figures (having the same size and shape), including shapes that have been rotated. **4.4.3.5.7** 8. Identifies a symmetric figure and determines all of its lines of symmetry. **4.4.3.5.8** 9. Recognizes slides, flips, and turns of pictured objects or geometric figures. **4.4.3.5.9** 10. Describes motion involving distance and direction on a grid or map, including maps with compass roses. **4.4.3.5.10** 11. Locates points on a grid with one axis labeled with letters and the other with numbers. **4.4.3.5.11**

Grade 4

Mathematics Content Standard 5

Students demonstrate understanding of measurable attributes and an ability to use measurement processes.

Benchmark End of Grade 4	GLCE Grade 4	Item Specification Grade 4
1. Estimates, measures, and investigates length, capacity, weight, mass, area, volume, time and temperature.	6. Identifies measurable attributes of objects (e.g., length, capacity, weight, mass, area, volume, time, temperature), and selects and uses appropriate tools to measure them.	1. Makes reasonable estimates of length, capacity, weight, or temperature for a given object or situation. **4.5.1.6.1** 2. Uses rulers to measure lengths to the nearest inch, half inch, quarter inch, or centimeter. **4.5.1.6.2** 3. Tells time, to the nearest minute, using analog and digital clocks. **4.5.1.6.3** 4. Uses a calendar to determine days of the week, dates, and elapsed time. **4.5.1.6.4** 5. Reads a pictured thermometer or scale to the nearest degree or whole number. **4.5.1.6.5** 6. Finds the perimeter (distance around) of a polygon. **4.5.1.6.6** 7. Finds the area of a rectangle or a region made up of squares and half squares shown on a grid or dot paper. **4.5.1.6.7** 8. Finds the volume of a prism composed of unit cubes. **4.5.1.6.8**
2. Develops the process of measuring and concepts related to units of measurement, including standard units (English and metric) and nonstandard units.		9. Performs one-step conversions between pairs of the following: inches, feet, and yards; millimeters, centimeters, and meters; cups, pints, quarts, and gallons; milliliters and liters; ounces and pounds; grams and kilograms; minutes, hours, days, weeks, and months. **4.5.2.6.9** 10. Solves problems involving elapsed time. **4.5.2.6.10**
3. Applies measurement skills to everyday situations.		11. Determines the value of a set of pictured coins and bills. **4.5.3.6.11**
4. Selects and uses appropriate tools and techniques.		12. Selects the best tool to use to measure length, capacity, weight/mass, or temperature of given object. **4.5.4.6.12** 13. Selects the best unit to use for a length, capacity, or weight/mass measurement. **4.5.4.6.13** 14. Recognizes that the size of the

		number in a measurement is dependent on the size of the unit used. **4.5.4.6.14**

Grade 4

Mathematics Content Standard 6

Students demonstrate understanding of and an ability to use data analysis, probability, and statistics.

Benchmark **End of Grade 4**	**GLCE Grade 3**	**Item Specification Grade 4**
1. Collects, organizes, and displays data.	7. Predicts and makes appropriate decisions using data (e.g., collects, organizes, constructs displays [including graphs], and interprets) to solve problems.	1. Selects questions to be asked and groups to be surveyed for a given purpose. **4.6.1.7.1** 2. Collects and organizes data, e.g., using charts, tally charts, and organized lists. **4.6.1.7.2**
2. Constructs, reads, and interprets displays of data, including graphs.		3. Reads and constructs bar graphs and pictographs. **4.6.2.7.3** 4. Makes informal judgments regarding the shape and spread of data sets. **4.6.2.7.4**
3. Formulates and solves problems that involve collecting and analyzing data.		5. Recognizes the most common data point (mode) and the "middle" data point (median) in a set of data. 4**.6.3.7.5** 6. Draws conclusions and makes simple inferences and predictions based on data given in charts, bar graphs, or pictographs. **4.6.3.7.6**
4. Demonstrates basic concepts of chance (e.g., equally likely events, simple probabilities).		7. Judges events as impossible, very likely, unlikely, or certain. **4.6.4.7.7** 8. Finds all possible outcomes of an experiment using a simple tree diagram or an organized list. **4.6.4.7.8** 9. Determines which outcomes in simple experiments are most or least likely to occur, e.g., in experiments involving spinners. **4.6.4.7.9**

Grade 4

Mathematics Content Standard 7

Students demonstrate understanding of and an ability to use patterns, relations, and functions.

Benchmark **End of Grade 4**	**GLCE Grade 4**	**Item Specification Grade 4**
1. Recognizes, describes, extends, and creates a variety of patterns.	8. Uses a variety of patterns to describe mathematical and real-world relationships.	1. Finds designated terms in a numeric or geometric pattern up to three positions beyond the displayed terms. **4.7.1.8.1** 2. Determines missing terms in numeric and geometric patterns. **4.7.1.8.2** 3. Represents rules for numeric patterns using words or symbols. **4.7.1.8.3** 4. Creates patterns, given a simple rule. **4.7.1.8.4**
2. Represents and describes mathematical and real-world relationships.		5. Recognizing different representations (e.g., words, charts, and graphs) of the same simple, linear, real-life situation. **4.7.2.8.5** 6. Matches a situation involving a constant rate of change to a chart, bar graph, or pictograph that best represents that situation. **4.7.2.8.6**

Grade 5

Mathematics Content Standard 1

Students engage in the mathematical process of problem solving and reasoning, estimation, communication, connections and applications, and using appropriate technology.

Benchmark End of Grade 8	GLCE Grade 5	Item Specification Grade 5
1. Formulates and solves multi-step and non-routine problems using a variety of strategies. Generalizes methods to new problem situations.	1. Selects and uses appropriate problem-solving strategies (e.g., estimate, make a table, look for a pattern, simplify the problem) and technologies (e.g., paper and pencil, calculator, computer) in many contexts. **5.1.1.1** **5.1.2.1** **5.1.3.1** **5.1.4.1** **5.1.5.1** 2. Communicates organized solutions to problems in a variety of ways (e.g., written, verbal, concrete, pictorial, graphical, algebraic). **5.1.1.2** **5.1.2.2** **5.1.3.2** **5.1.4.2** **5.1.5.2**	Standard 1 is embedded throughout the Benchmarks and GLCEs to emphasize the importance of the mathematical processes of problem solving and reasoning, estimation, communication, connections and applications, and using appropriate technology as part of every strand.
2. Selects and applies appropriate estimation strategies throughout the problem-solving process.		
3. Interprets and communicates mathematical ideas and logical arguments using correct mathematical terms and notations.		
4. Recognizes and investigates the relevance and usefulness of mathematics through applications, both in and out of school.		
5. Selects and uses appropriate technology to enhance mathematical understanding. Appropriate technology may include, but is not limited to, paper and pencil, calculator, computer, and data collection devices.		

Grade 5

Mathematics Content Standard 2

Students demonstrate understanding of and an ability to use numbers and operations.

Benchmark End of Grade 8	GLCE Grade 5	Item Specification Grade 5
1. Uses the four basic operations with whole numbers, fractions, decimals, and integers.	3. Uses addition, subtraction, multiplication, and division of whole numbers and decimals to estimate, compute, and determine relationships in everyday situations.	1. Relates addition, subtraction, and multiplication of fractions to pictorial models or real-life situations. **5.2.1.3.1** 2. Multiplies and divides with whole numbers and money. **5.2.1.3.2** 3. Solves multi-step problems involving whole numbers and money. **5.2.1.3.3** 4. Adds and subtracts decimals through thousandths. **5.2.1.3.4** 5. Solves fraction problems based on models, number sense, or estimation. **5.2.1.3.5**
2. Uses mental mathematics and number sense in using order of operations, and order relations for whole numbers, fractions, decimals, and integers.		6. Reads and writes whole numbers through trillions. **5.2.2.3.6** 7. Recognizes place value in decimals. **5.2.2.3.7** 8. Rounds whole numbers and decimals to specified place value positions. **5.2.2.3.8** 9. Recognizes and generates fractional and decimal equivalents for commonly used fractions. **5.2.2.3.9** 10. Orders commonly used fractions and decimals through thousandths with and without models. **5.2.2.3.10** 11. Recognizes the relationships among the four operations on whole numbers. **5.2.2.3.11** 12. Estimates based on addition, subtraction, multiplication, and division. **5.2.2.3.12**
3. Uses the relationships and applications of ratio, proportion, percent, and scientific notation.		Not assessed at this grade level.
4. Develops and applies number theory concepts (e.g., prime numbers, factors and multiples) in real-world and mathematical problem situations.		13. Recognizes prime and composite numbers. **5.2.4.3.13** 14. Finds common multiples and common divisors. **5.2.4.3.14**

Grade 5

Mathematics Content Standard 3

Students use algebraic concepts, processes, and language to model and solve a variety of real-world and mathematical problems.

Benchmark End of Grade 8	GLCE Grade 5	Item Specification Grade 5
1. Understands the concepts of variable, expression, and equation.	4. Applies basic algebraic concepts and communicates different representations of the same relationship (e.g., number sentence, picture).	1. Solves problems such as balance scale problems that serve as readiness activities for solving equations using algebraic methods. **5.3.1.4.1**
2. Represents situations and number patterns using tables, graphs, verbal rules, equations, and models.		2. Represents rules for numeric patterns using words, symbols, or simple algebraic expressions. **5.3.2.4.2** 3. Represents linear, real-life situations with simple algebraic expressions or equations. **5.3.2.4.3**
3. Recognizes and uses the general properties of operations (e.g., the distributive property).		4. Applies the commutative, associative, identity, and distributive properties. **5.3.3.4.4**
4. Solves linear equations using concrete, numerical, and algebraic methods.		5. Uses inspection to find the solution to a simple linear equation. **5.3.4.4.5** 6. Finds numerical replacements for variables, represented by a symbol or letter, to make number sentences true. **5.3.4.4.6**
5. Investigates inequalities and non linear relationships informally.		Not assessed at this grade level.

Grade 5

Mathematics Content Standard 4

Students demonstrate understanding of shape and an ability to use geometry.

Benchmark End of Grade 8	GLCE Grade 5	Item Specification Grade 5
1. Identifies, describes, constructs and compares plane and solid geometric figures.	5. Identifies shapes and accurately uses relationships among shapes (e.g., combinations, subdivisions, symmetry, congruence, position) to solve problems in the physical world.	1. Uses properties to describe and identify two- and three-dimensional figures. **5.4.1.5.1** 2. Recognizes congruent figures, including shapes that have been rotated or reflected. **5.4.1.5.2** 3. Identifies a net (pattern) of a three-dimensional figure such as a cube or square prism. **5.4.1.5.3**
2. Understands and applies geometric properties and relationships (e.g. the Pythagorean theorem).		4. Reasons about geometric figures based on their definitions and properties, e.g., a square is also a rectangle and a parallelogram. **5.4.2.5.4**
3. Represents geometric figures on a coordinate grid.		5. Uses ordered pairs as coordinates of points in the first quadrant of a coordinate plane. **5.4.3.5.5**
4. Explores properties and transformations of geometric figures.		6. Identifies a symmetric figure and determining all of its lines of symmetry. **5.4.4.5.6** 7. Identifies figures with rotational symmetry and determining the types of turns that result in matches to the original figure. **5.4.4.5.7** 8. Identifies the result of translating (sliding), reflecting (flipping), or rotating (turning) a geometric figure. **5.4.4.5.8** 9. Describes translations, reflections, and rotations including the use of terms such as horizontal, vertical, counterclockwise, 90^{o}, and 180^{o}. **5.4.4.5.9**
5. Uses geometry as a means of describing the physical world.		10. Represents points, lines, line segments, rays, and angles with models and symbols. **5.4.5.5.10** 11. Recognizes the results of subdividing and combining shapes. **5.4.5.5.11** 12. Identifies views (e.g., front, top, right side) of a structure built from cubes. **5.4.5.5.12**

Grade 5

Mathematics Content Standard 5

Students demonstrate understanding of measurable attributes and an ability to use measurement processes.

Benchmark End of Grade 8	GLCE Grade 5	Item Specification Grade 5
1. Estimates, makes and uses measurements to describe, compare, and/or contrast objects in real-world situations.	6. Selects appropriate units for measurements, including square and cubic units.	1. Recognizes the relationship between the size of the number in a measurement and the size of the unit used. **5.5.1.6.1** 2. Recognizes 90^{o} angles as well as angles with measures greater than or less than 90^{o}. **5.5.1.6.2** 3. Makes reasonable estimates of length, capacity, weight, or temperature for a given object or situation. **5.5.1.6.3**
2. Selects and uses appropriate units and tools to measure to a level of accuracy required in a particular setting.		4. Selects the best unit to use relative to the purpose of the measurement as well as the type of measurement. **5.5.2.6.4** 5. Uses rulers to measure lengths to the nearest inch, half inch, quarter inch, eighth inch, centimeter, or millimeter. **5.5.2.6.5**
3. Applies the concepts of perimeter, area, volume and capacity, weight and mass, angle measure, time, and temperature.		6. Recognizing that a change in perimeter or area of a polygon may or may not change the other measurement. **5.5.3.6.6** 7. Solves problems involving elapsed time, thermometers, and scales. **5.5.3.6.7** 8. Finds the perimeter of a polygon. **5.5.3.6.8** 9. Finds the area of a rectangle or a region that can be subdivided into rectangles. **5.5.3.6.9**
4. Demonstrates understanding of the structure and use of systems of measurement, including English and metric.		10. Selects the correct unit (linear, square, or cubic) to use for linear, area, or volume measurement. **5.5.4.6.10** 11. Performs conversions between pairs of the following: inches, feet, yards and miles; millimeters, centimeters, meters, and kilometers; cups, pints, quarts, and gallons; milliliters and liters; ounces and pounds; grams and kilograms; minutes, hours, days, weeks, months, and years. **5.5.4.6.11**
5. Uses the concepts of rates and other derived and indirect measures.		Not assessed at this grade level.
6. Demonstrates		12. Finds the volume of a prism

relationships between formulas and procedures for determining area and volume.		composed of unit cubes. **5.5.6.6.12**

Grade 5

Mathematics Content Standard 6

Students demonstrate understanding of and an ability to use data analysis, probability, and statistics.

Benchmark End of Grade 8	**GLCE Grade 5**	**Item Specification Grade 5**
1. Systematically collects, organizes, and describes data.	7. Predicts and makes appropriate decisions using data (e.g., collects, organizes, graphs, and interprets data).	1. Selects questions to be asked and groups to be surveyed for a given purpose. **5.6.1.7.1** 2. Collects and organizes data, e.g., using charts, tally charts, and organized lists. **5.6.1.7.2**
2. Constructs, reads, and interprets tables, charts, and graphs.		3. Reads and constructs bar graphs, pictographs, line graphs, and line plots. **5.6.2.7.3**
3. Draws inferences, constructs, and evaluates arguments based on data analysis and measures of central tendency.		4. Calculates the mean, median, mode, and range of a data set and interprets their meanings relative to the data set. **5.6.3.7.4** 5. Makes judgments regarding the shape and spread of data sets. **5.6.3.7.5** 6. Draws conclusions and makes inferences and predictions based on data given in charts or graphs. **5.6.3.7.6**
4. Constructs sample spaces and determines the theoretical and experimental probabilities of events.		7. Finds all possible outcomes of an experiment using a simple tree diagram or an organized list. **5.6.4.7.7**
5. Makes predictions based on experimental results or probabilities.		8. Predicts the number of successes in multiple trials of a simple experiment, e.g., in experiments involving drawing colored marbles from a bag containing a given number of marbles of each color. **5.6.5.7.8**

Grade 5

Mathematics Content Standard 7

Students demonstrate understanding of and an ability to use patterns, relations, and functions.

Benchmark End of Grade 8	**GLCE Grade 5**	**Item Specification Grade 5**
1. Describes, extends, analyzes, and creates a variety of patterns and functions.	8. Uses and analyzes a variety of patterns to describe mathematical and real-world relationships in various ways.	1. Finds designated terms in a numeric or geometric pattern. **5.7.1.8.1**
2. Describes and represents relationships with tables, graphs, and rules.		2. Recognizes and creates various representations of simple, linear, real-life situations. **5.7.2.8.2**
3. Analyzes functional relationships to explain how a change in one quantity results in a change in another.		3. Matches a situation involving a constant or varying rate of change to a table or graph that best represents the situation. **5.7.3.8.3**
4. Uses patterns and functions to represent and solve problems.		Not assessed at this grade level.
5. Describes functions using graphical, numerical, physical, algebraic, and verbal models or representations.		Not assessed at this grade level.

Grade 6

Mathematics Content Standard 1

Students engage in the mathematical process of problem solving and reasoning, estimation, communication, connections and applications, and using appropriate technology.

Benchmark End of Grade 8	GLCE Grade 6	Item Specification Grade 6
1. Formulates and solves multi-step and non-routine problems using a variety of strategies. Generalizes methods to new problem situations.	1. Selects and uses appropriate problem-solving strategies (e.g., estimate, make a table, look for a pattern, simplify the problem) and technologies (e.g., paper and pencil, calculator, computer) in many contexts. **6.1.1.1** **6.1.2.1** **6.1.3.1** **6.1.4.1** **6.1.5.1** 2. Communicates organized solutions to problems in a variety of ways (e.g., written, verbal, concrete, pictorial, graphical, algebraic) and provides appropriate support (e.g., reasons, rationales). **6.1.1.2** **6.1.2.2** **6.1.3.2** **6.1.4.2** **6.1.5.2**	Standard 1 is embedded throughout the Benchmarks and GLCEs to emphasize the importance of the mathematical processes of problem solving and reasoning, estimation, communication, connections and applications, and using appropriate technology as part of every strand.
2. Selects and applies appropriate estimation strategies throughout the problem-solving process.		
3. Interprets and communicates mathematical ideas and logical arguments using correct mathematical terms and notations.		
4. Recognizes and investigates the relevance and usefulness of mathematics through applications, both in and out of school.		
5. Selects and uses appropriate technology to enhance mathematical understanding. Appropriate technology may include, but is not limited to, paper and pencil, calculator, computer, and data collection devices.		

Grade 6

Mathematics Content Standard 2

Students demonstrate understanding of and an ability to use numbers and operations.

Benchmark End of Grade 8	GLCE Grade 6	Item Specification Grade 6
1. Uses the four basic operations with whole numbers, fractions, decimals, and integers.	3. Uses addition, subtraction, multiplication, and division of whole numbers, decimals, and fractions to estimate and compute, and to determine whether results are accurate and reasonable.	1. Judges the effects of addition, subtraction, multiplication, and division with fractions and decimals. **6.2.1.3.1** 2. Adds, subtracts, multiplies, and divides with whole numbers, fractions, and decimals. **6.2.1.3.2**
2. Uses mental mathematics and number sense in using order of operations, and order relations for whole numbers, fractions, decimals, and integers.		3. Translates among forms for expressing large numbers, e.g., standard notation, expanded form, words. **6.2.2.3.3** 4. Recognizes and generates equivalences between fractions and decimals. **6.2.2.3.4** 5. Relates whole number percent between 1% and 100% to their fraction and decimal equivalent. **6.2.2.3.5** 6. Orders and compares whole numbers, mixed numbers, fractions, and decimals. **6.2.2.3.6** 7. Applies the correct order of operations to simple expressions or with whole number expressions. **6.2.2.3.7** 8. Estimates based on the four operations with whole numbers, fractions, and decimals. **6.2.2.3.8**
3. Uses the relationships and applications of ratio, proportion, percent, and scientific notation.		9. Recognizes and generates equivalent fractions and equivalent ratios. **6.2.3.3.9** 10. Finds percents of numbers. **6.2.3.3.10**
4. Develops and applies number theory concepts (e.g., prime numbers, factors and multiples) in real-world and mathematical problem situations.		11. Recognizes the meaning of exponents. **6.2.4.3.11** 12. Finds prime factorizations, least common multiples, and greatest common divisors. **6.2.4.3.12**

Grade 6

Mathematics Content Standard 3

Students use algebraic concepts, processes, and language to model and solve a variety of real-world and mathematical problems.

Benchmark End of Grade 8	GLCE Grade 6	Item Specification Grade 6
1. Understands the concepts of variable, expression, and equation.	4. Uses basic algebraic concepts and represents relationships in appropriate ways (e.g., number sentence, picture, graph) to solve selected problems.	1. Solves problems such as balance scale problems that serve as readiness activities for equation solution using algebraic methods. **6.3.1.4.1**
2. Represents situations and number patterns using tables, graphs, verbal rules, equations, and models.		2. Represents linear, real-life situations with simple algebraic expressions or equations. **6.3.2.4.2**
3. Recognizes and uses the general properties of operations (e.g., the distributive property).		3. Applies the commutative, associative, identity, and distributive properties and the multiplicative inverse property. **6.3.3.4.3**
4. Solves linear equations using concrete, numerical, and algebraic methods.		4. Solves linear equations involving a single step. **6.3.4.4.4** 5. Evaluates expressions for given values, e.g., in formulas such as the formula for the area of a rectangle. **6.3.4.4.5**
5. Investigates inequalities and non linear relationships informally.		Not assessed at this grade level.

Grade 6

Mathematics Content Standard 4

Students demonstrate understanding of shape and an ability to use geometry.

Benchmark End of Grade 8	GLCE Grade 6	Item Specification Grade 6
1. Identifies, describes, constructs and compares plane and solid geometric figures.	5. Applies geometric relationships (eg., symmetry, congruence, position) to solve selected problems.	1. Reasons about geometric figures and the relationships among them based on their definitions and properties. **6.4.1.5.1** 2. Identifies congruent shapes, including those shown on dot or grid paper. **6.4.1.5.2** 3. Identifies a net (pattern) for a common three-dimensional figure such as a prism or pyramid. **6.4.1.5.3**
2. Understands and applies geometric properties and relationships (e.g. the Pythagorean theorem).		4. Determines characteristics of various polygons including isosceles, scalene, and equilateral triangles. **6.4.2.5.4**
3. Represents geometric figures on a coordinate grid.		5. Uses ordered pairs as coordinates of points in a four-quadrant coordinate plane. **6.4.3.5.5**
4. Explores properties and transformations of geometric figures.		6. Identifies figures with rotational symmetry and determines the number of different turns that result in matches to the original figure. **6.4.4.5.6** 7. Identifies the result of translating, reflecting, or rotating a geometric figure. **6.4.4.5.7** 8. Describes or identifies the transformation (translation, reflection, or rotation) that moves a figure from one position to another. **6.4.4.5.8**
5. Uses geometry as a means of describing the physical world.		9. Represents points, lines, line segments, rays, and angles with models and symbols. **6.4.5.5.9** 10. Identifies views (e.g., front, top, right side) of a structure built from cubes. **6.4.5.5.10**

Grade 6

Mathematics Content Standard 5

Students demonstrate understanding of measurable attributes and an ability to use measurement processes.

Benchmark End of Grade 8	GLCE Grade 6	Item Specification Grade 6
1. Estimates, makes and uses measurements to describe, compare, and/or contrast objects in real-world situations.	6. Performs conversions among basic units within a system of measurement and determines the areas of geometric figures.	1. Estimates equivalent measures between the customary and metric systems based on benchmark equivalents. **6.5.1.6.1** 2. Makes reasonable estimates of distance or height based on common benchmarks or given information, e.g., an estimate of the height of a tree, given a picture of a man standing next to the tree. **6.5.1.6.2** 3. Uses protractors to measure angles to the nearest degree. **6.5.1.6.3** 4. Estimates perimeters and areas of irregular regions shown on a grid. **6.5.1.6.4** 5. Solves problems involving scale factors in maps and scale models. **6.5.1.6.5**
2. Selects and uses appropriate units and tools to measure to a level of accuracy required in a particular setting.		6. Selects the best unit to use relative to the purpose of the measurement as well as the type of measurement. **6.5.2.6.6**
3. Applies the concepts of perimeter, area, volume and capacity, weight and mass, angle measure, time, and temperature.		7. Determines how a change in side length affects the perimeter or area of a rectangle. **6.5.3.6.7** 8. Finds perimeters of polygons and, given the formula, circumferences of circles. **6.5.3.6.8**
4. Demonstrates understanding of the structure and use of systems of measurement, including English and metric.		9. Selects the correct unit (linear, square, or cubic) to use for linear, area, or volume measurement. **6.5.4.6.9** 10. Performs conversions among measurements of area and volume, e.g., 1 square centimeter is equal to 100 square millimeters. **6.5.4.6.10** 11. Performs conversions among customary units and among metric units for linear measurements and measurements of capacity and weight. **6.5.4.6.11**
5. Uses the concepts of rates and other derived and indirect measures.		12. Solves problems involving rates and common derived measurements, e.g. miles per gallon and cost per unit.

		6.5.5.6.12
6. Demonstrates relationships between formulas and procedures for determining area and volume.		13. Uses given formulas to find the areas of triangles, parallelograms, trapezoids, and circles as well as figures that can be subdivided into rectangles. **6.5.6.6.13** 14. Uses given formulas to find the volumes of prisms and cylinders. **6.5.6.6.14**

Grade 6

Mathematics Content Standard 6

Students demonstrate understanding of and an ability to use data analysis, probability, and statistics.

Benchmark End of Grade 8	GLCE Grade 6	Item Specification Grade 6
1. Systematically collects, organizes, and describes data.	7. Makes reasonable predictions based on data, basic probability, and statistics (e.g., tables, charts, graphs).	1. Determines appropriate data to collect for a given purpose and how to go about collecting and analyzing those data. **6.6.1.7.1** 2. Selects appropriate graphic representations for data sets. **6.6.1.7.2**
2. Constructs, reads, and interprets tables, charts, and graphs.		3. Reads and constructs bar graphs, pictographs, line graphs, line plots, stem-and-leaf graphs, circle gaphs, frequency charts, and histograms. **6.6.2.7.3**
3. Draws inferences, constructs, and evaluates arguments based on data analysis and measures of central tendency.		4. Calculates the mean, median, mode, and range of a data set and interprets their meanings relative to the data set. **6.6.3.7.4** 5. Makes judgments regarding the shape and spread of data sets. **6.6.3.7.5** 6. Draws conclusions and makes inferences and predictions based on data given in charts or graphs. **6.6.3.7.6**
4. Constructs sample spaces and determines the theoretical and experimental probabilities of events.		7. Determines all possible outcomes for an experiment, using a tree diagram, an organized list, or, when appropriate, the fundamental counting principle. **6.6.4.7.7** 8. Finds the theoretical probability of an event in an experiment with equally likely outcomes. **6.6.4.7.8** 9. Finds the experimental probability of an event, given a set of data. **6.6.4.7.9**
5. Makes predictions based on experimental results or probabilities.		10. Makes predictions based on given probabilities. **6.6.5.7.10**

Grade 6

Mathematics Content Standard 7

Students demonstrate understanding of and an ability to use patterns, relations, and functions.

Benchmark End of Grade 8	**GLCE Grade 6**	**Item Specification Grade 6**
1. Describes, extends, analyzes, and creates a variety of patterns and functions.	8. Uses and analyzes a variety of patterns to describe mathematical and real-world relationships in various ways.	1. Finds any designated term in a numeric or geometric pattern. **6.7.1.8.1**
2. Describes and represents relationships with tables, graphs, and rules.		2. Recognizes and creates multiple representations (e.g., words, charts, algebraic expressions or equations, and graphs) of the same simple, linear, real-life situation. **6.7.2.8.2**
3. Analyzes functional relationships to explain how a change in one quantity results in a change in another.		3. Matches a situation involving a constant or variable rate of change, described without the use of exact data, to a table or graph that best represents that situation. **6.7.3.8.3**
4. Uses patterns and functions to represent and solve problems.		4. Draws conclusions and makes predictions based on linear patterns. **6.7.4.8.4**
5. Describes functions using graphical, numerical, physical, algebraic, and verbal models or representations.		5. Recognizes the relationship between linear equations and their graphs, given real-life situations that are linear. **6.7.5.8.5**

Grade 7

Mathematics Content Standard 1

Students engage in the mathematical process of problem solving and reasoning, estimation, communication, connections and applications, and using appropriate technology.

Benchmark End of Grade 8	GLCE Grade 7	Item Specification Grade 7
1. Formulates and solves multi-step and non-routine problems using a variety of strategies. Generalizes methods to new problem situations.	1. Selects and uses appropriate problem-solving strategies (e.g., estimate, make a table, look for a pattern, simplify the problem) and technologies (e.g., paper and pencil, calculator, computer, data collection devices) in many contexts. **7.1.1.1** **7.1.2.1** **7.1.3.1** **7.1.4.1** **7.1.5.1** 2. Communicates organized solutions to problems in a variety of ways (e.g., written, verbal, concrete, pictorial, graphical, algebraic) and provides appropriate support (reasons, rationales). **7.1.1.2** **7.1.2.2** **7.1.3.2** **7.1.4.2** **7.1.5.2**	Standard 1 is embedded throughout the Benchmarks and GLCEs to emphasize the importance of the mathematical processes of problem solving and reasoning, estimation, communication, connections and applications, and using appropriate technology as part of every strand.
2. Selects and applies appropriate estimation strategies throughout the problem-solving process.		
3. Interprets and communicates mathematical ideas and logical arguments using correct mathematical terms and notations.		
4. Recognizes and investigates the relevance and usefulness of mathematics through applications, both in and out of school.		
5. Selects and uses appropriate technology to enhance mathematical understanding. Appropriate technology may include, but is not limited to, paper and pencil, calculator, computer, and data collection devices.		

Grade 7

Mathematics Content Standard 2

Students demonstrate understanding of and an ability to use numbers and operations.

Benchmark End of Grade 8	GLCE Grade 7	Item Specification Grade 7
1. Uses the four basic operations with whole numbers, fractions, decimals, and integers.	3. Uses rational numbers, proportions, and percents to solve problems.	1. Adds, subtracts, multiplies, and divides with whole numbers, fractions, decimals, and integers. **7.2.1.3.1** 2. Uses positive and negative integers to represent real-life situations. **7.2.1.3.2** 3. Recognizes or justifies the effect of addition, subtraction, multiplication, and division on rational numbers as well as the effects of operations with exponents and square roots. **7.2.1.3.3**
2. Uses mental mathematics and number sense in using order of operations, and order relations for whole numbers, fractions, decimals, and integers.		4. Estimates based on the operations of addition, subtraction, multiplication and division with whole numbers, fractions, decimals, and integers. **7.2.2.3.4** 5. Recognizes and generates equivalent fractions, decimals, and percents. **7.2.2.3.5** 6. Orders rational numbers and perfect square roots. **7.2.2.3.6** 7. Applies the correct order of operations. **7.2.2.3.7**
3. Uses the relationships and applications of ratio, proportion, percent, and scientific notation.		8. Translates among forms for expressing large numbers, including scientific notation. **7.2.3.3.8** 9. Interprets the meanings of proportions and percents, including percents less than 1% and greater than 100%, in real-life situations. **7.2.3.3.9** 10. Recognizes the relationships among ratios, proportions, and percents. **7.2.3.3.10** 11. Computes with ratios, proportions, and percents. **7.2.3.3.11**
4. Develops and applies number theory concepts (e.g., prime numbers, factors and multiples) in real-world and mathematical problem situations.		12. Applies and uses multiples, factors, primes, and divisibility. **7.2.4.3.12**

Grade 7

Mathematics Content Standard 3

Students use algebraic concepts, processes, and language to model and solve a variety of real-world and mathematical problems.

Benchmark End of Grade 8	GLCE Grade 7	Item Specification Grade 7
1. Understands the concepts of variable, expression, and equation.	4. Uses basic algebraic concepts and represents relationships in appropriate ways (e.g., number sentence, picture, graph) to solve real-world problems.	1. Evaluates expressions for given values, e.g., geometric or measurement formulas or in expressions representing real-life situations. **7.3.1.4.1** 2. Recognizes the equivalence of expressions as they relate to the same real-life situation. **7.3.1.4.2**
2. Represents situations and number patterns using tables, graphs, verbal rules, equations, and models.		3. Represents rules for real-life and mathematical linear patterns using words, algebraic expressions, or equations. **7.3.2.4.3**
3. Recognizes and uses the general properties of operations (e.g., the distributive property).		4. Applies the commutative, associative, identity, inverse, and distributive properties. **7.3.3.4.4**
4. Solves linear equations using concrete, numerical, and algebraic methods.		5. Solves linear equations in one variable with non-negative integral solutions. **7.3.4.4.5**
5. Investigates inequalities and non linear relationships informally.		Not assessed at this grade level.

Grade 7

Mathematics Content Standard 4

Students demonstrate understanding of shape and an ability to use geometry.

Benchmark End of Grade 8	**GLCE Grade 7**	**Item Specification Grade 7**
1. Identifies, describes, constructs and compares plane and solid geometric figures.	5. Applies geometric relationships such as coordinates and transformations to solve selected problems.	1. Determines characteristics of and relationships among various types of triangles and angles, including vertical, complementary, and supplementary angles. **7.4.1.5.1** 2. Constructs a net (pattern) for a common three-dimensional figure such as a prism or pyramid. **7.4.1.5.2**
2. Understands and applies geometric properties and relationships (e.g. the Pythagorean theorem).		3. Describes the relationship among geometric figures based on their definitions and properties . **7.4.2.5.3**
3. Represents geometric figures on a coordinate grid.		4. Uses ordered pairs as coordinates of points in a four-quadrant plane. **7.4.3.5.4** 5. Makes connections between properties of geometric figures and coordinate geometry, e.g., given the coordinates of three vertices of a square, finding the coordinates of the fourth vertex. **7.4.3.5.5**
4. Explores properties and transformations of geometric figures.		6. Describes in words the transformation (translation, reflection, or rotation) that moves a figure from one position to another. **7.4.4.5.6** 7. Determines an image of a figure on the coordinate plane after a translation or reflection. **7.4.4.5.7** 8. Recognizes the connections between transformations and congruence, line symmetry, and rotational symmetry. **7.4.4.5.8**
5. Uses geometry as a means of describing the physical world.		9. Determines similarity of geometric figures based on congruence of angles and proportionality of sides. **7.4.5.5.9** 10. Identifies views (e.g., front, top, right side) of a three-dimensional structure. **7.4.5.5.10**

Grade 7

Mathematics Content Standard 5

Students demonstrate understanding of measurable attributes and an ability to use measurement processes.

Benchmark End of Grade 8	GLCE Grade 7	Item Specification Grade 7
1. Estimates, makes and uses measurements to describe, compare, and/or contrast objects in real-world situations.	6. Uses formulas to determine areas and volumes.	1. Makes reasonable estimates of distance or height based on common benchmarks or given information, e.g., an estimate of the height of a tree, given a picture of a man standing next to the tree. **7.5.1.6.1** 2. Estimates perimeters and areas of irregular regions. **7.5.1.6.2**
2. Selects and uses appropriate units and tools to measure to a level of accuracy required in a particular setting.		3. Selects the best measurement strategy to use relative to the purpose of the measurement and its required accuracy. **7.5.2.6.3** 4. Identifies the range of possible "true" measurements, given the measurement with it greatest possible error. **7.5.2.6.4**
3. Applies the concepts of perimeter, area, volume and capacity, weight and mass, angle measure, time, and temperature.		5. Uses formulas to determine how a change in side length (radius) or height affects the perimeter (circumference) and area in triangles, parallelograms and circles, and the volume in rectangular and triangular prisms. **7.5.3.6.5** 6. Predicts how a change in one of the measures of side lengths, perimeters, and areas affect the other of these measurements in a triangle, square, or rectangle. **7.5.3.6.6**
4. Demonstrates understanding of the structure and use of systems of measurement, including English and metric.		7. Performs conversions among measurements of area and volume, e.g., 1 square centimeter is equal to 100 square millimeters. Performs conversions among customary units and among metric units for linear measurements and measurements of capacity and weight. **7.5.4.6.7**
5. Uses the concepts of rates and other derived and indirect measures.		8. Solves problems involving rates and common derived measurements, e.g., miles per gallon and cost per unit. **7.5.5.6.8** 9. Solves problems involving scale factors, e.g., maps and enlargements made with a photocopier. **7.5.5.6.9** 10. Solves problems involving proportionality and geometric similarity. **7.5.5.6.10**

6. Demonstrates relationships between formulas and procedures for determining area and volume.		11. Finds perimeters of polygons and, given the formula, circumference of circles. **7.5.6.6.11** 12. Uses given formulas to find the area of rectangles, triangles, parallelograms, trapezoids, and circles as well as figures that can be subdivided into these shapes. **7.5.6.6.12** 13. Uses given formulas to find the volume of prisms, cylinders, cones, and pyramids. **7.5.6.6.13**

Grade 7

Mathematics Content Standard 6

Students demonstrate understanding of and an ability to use data analysis, probability, and statistics.

Benchmark End of Grade 8	GLCE Grade 7	Item Specification Grade 7
1. Systematically collects, organizes, and describes data.	7. Makes reasonable predictions based on data, basic probability, and statistics (e.g., tables, charts, graphs).	1. Determines appropriate data to collect for a given purpose and how to go about collecting and analyzing those data. **7.6.1.7.1**
2. Constructs, reads, and interprets tables, charts, and graphs.		2. Selects appropriate graphic representations for data sets. **7.6.2.7.2** 3. Constructs and interprets bar graphs, pictographs, line graphs, line plots, stem-and-leaf graphs, circle graphs, frequency charts, histograms, and box-and-whisker graphs. **7.6.2.7.3**
3. Draws inferences, constructs, and evaluates arguments based on data analysis and measures of central tendency.		4. Recognizes how different representations of the same data can affect their interpretation. **7.6.3.7.4** 5. Calculates the mean, median, mode, and range of data set and interprets their meanings relative to the data set. **7.6.3.7.5** 6. Makes judgments regarding the shape and spread of data sets, including consideration of outliers and quartiles. **7.6.3.7.6** 7. Draws conclusions and makes inferences and predictions based on data given in charts and graphs. **7.6.3.7.7**
4. Constructs sample spaces and determines the theoretical and experimental probabilities of events.		8. Determines all possible outcomes for an experiment, using a tree diagram, an organized list, or when appropriate, the fundamental counting principle. **7.6.4.7.8** 9. Finds the theoretical probability of an event in an experiment with equally likely outcomes. **7.6.4.7.9** 10. Finds theoretical probability involving simple, independent events. **7.6.4.7.10** 11. Finds the empirical probability of an event, given a set of data. **7.6.4.7.11**
5. Makes predictions based on experimental results or probabilities.		12. Makes predictions based on probability. **7.6.5.7.12**

Grade 7

Mathematics Content Standard 7

Students demonstrate understanding of and an ability to use patterns, relations, and functions.

Benchmark End of Grade 8	**GLCE Grade 7**	**Item Specification Grade 7**
1. Describes, extends, analyzes, and creates a variety of patterns and functions.	8. Analyzes and describes patterns and functions using various representations (e.g., tables, graphs, verbal rules).	1. Draws conclusions and makes predictions based on patterns and relationships, both mathematical and from real-life. **7.7.1.8.1** 2. Draws conclusions and makes predictions based on linear patterns. **7.7.1.8.2**
2. Describes and represents relationships with tables, graphs, and rules.		3. Recognizes and creates multiple representations (e.g., words, charts, algebraic expressions or equations, and graphs) of the same linear, real-life situation. **7.7.2.8.3**
3. Analyzes functional relationships to explain how a change in one quantity results in a change in another.		4. Determines in a real-life situation involving a constant rate of change how a change in one variable affects the other variable. **7.7.3.8.4**
4. Uses patterns and functions to represent and solve problems.		5. Represents linear, real-life situations with algebraic expressions or equations. **7.7.4.8.5**
5. Describes functions using graphical, numerical, physical, algebraic, and verbal models or representations.		6. Matches a situation involving a constant or variable rate of change to a graph that best represents that situation. **7.7.5.8.6** 7. Recognizes the relationship between linear equations and their graphs. **7.7.5.8.7**

Grade 8

Mathematics Content Standard 1

Students engage in the mathematical process of problem solving and reasoning, estimation, communication, connections and applications, and using appropriate technology.

Benchmark End of Grade 8	GLCE Grade 8	Item Specification Grade 8
1. Formulates and solves multi-step and non-routine problems using a variety of strategies. Generalizes methods to new problem situations.	1. Selects and uses appropriate processes (e.g., estimation, multiple steps) and technologies (e.g., paper and pencil, calculator, computer, data collection devices) in many contexts. **8.1.1.1** **8.1.2.1** **8.1.3.1** **8.1.4.1** **8.1.5.1** 2. Formulates and communicates logical arguments using appropriate mathematical ideas (e.g., mathematical terms, notations). **8.1.1.2** **8.1.2.2** **8.1.3.2** **8.1.4.2** **8.1.5.2**	Standard 1 is embedded throughout the Benchmarks and GLCEs to emphasize the importance of the mathematical processes of problem solving and reasoning, estimation, communication, connections and applications, and using appropriate technology as part of every strand.
2. Selects and applies appropriate estimation strategies throughout the problem-solving process.		
3. Interprets and communicates mathematical ideas and logical arguments using correct mathematical terms and notations.		
4. Recognizes and investigates the relevance and usefulness of mathematics through applications, both in and out of school.		
5. Selects and uses appropriate technology to enhance mathematical understanding. Appropriate technology may include, but is not limited to, paper and pencil, calculator, computer, and data collection devices.		

Grade 8

Mathematics Content Standard 2

Students demonstrate understanding of and an ability to use numbers and operations.

Benchmark End of Grade 8	GLCE Grade 8	Item Specification Grade 8
1. Uses the four basic operations with whole numbers, fractions, decimals, and integers.	3. Uses rational numbers and proportionality (e.g., ratio, proportion, percent) to represent and solve problems and determine whether results are accurate.	1. Adds, subtracts, multiplies, and divides with rational numbers, including negative rational numbers. **8.2.1.3.1** 2. Recognizes the effects of addition, subtraction, multiplication, and division with rational numbers as well as the effects of operations with exponents and square roots. **8.2.1.3.2**
2. Uses mental mathematics and number sense in using order of operations, and order relations for whole numbers, fractions, decimals, and integers.		3. Estimates based on addition, subtraction, multiplication, and division. **8.2.2.3.3** 4. Applies the correct order of operations and laws of exponents. **8.2.2.3.4** 5. Uses positive and negative rational numbers to represent real-life situations. **8.2.2.3.5** 6. Interprets integral exponents and roots. **8.2.2.3.6** 7. Recognizes and generates equivalent fractions, decimals, and percents. **8.2.2.3.7** 8. Orders rational numbers and square roots. **8.2.2.3.8**
3. Uses the relationships and applications of ratio, proportion, percent, and scientific notation.		9. Translates among forms for expressing large and small numbers, including scientific notation. **8.2.3.3.9** 10. Solves or applies the applications of proportions and percents to solve real-life situations. **8.2.3.3.10** 11. Computes with ratios, proportions, and percents. **8.2.3.3.11**
4. Develops and applies number theory concepts (e.g., prime numbers, factors and multiples) in real-world and mathematical problem situations.		12. Uses multiples, factors, primes, and divisibility to solve problems. **8.2.4.3.12**

Grade 8

Mathematics Content Standard 3

Students use algebraic concepts, processes, and language to model and solve a variety of real-world and mathematical problems.

Benchmark End of Grade 8	GLCE Grade 8	Item Specification Grade 8
1. Understands the concepts of variable, expression, and equation.	4. Uses algebra concepts (e.g., variable) and methods (e.g., equation, graph) to represent and solve real-world problems.	1. Evaluates expressions for given values. **8.3.1.4.1** 2. Recognizes and writes equivalent expressions. **8.3.1.4.2**
2. Represents situations and number patterns using tables, graphs, verbal rules, equations, and models.		3. Represents rules for real-life and mathematical patterns using words, algebraic expressions, or equations. **8.3.2.4.3**
3. Recognizes and uses the general properties of operations (e.g., the distributive property).		4. Applies the commutative, associative, identity, inverse, and distributive properties. **8.3.3.4.4**
4. Solves linear equations using concrete, numerical, and algebraic methods.		5. Solves linear equations in one variable. **8.3.4.4.5**
5. Investigates inequalities and non linear relationships informally.		6. Graphs linear equations and inequalities. **8.3.5.4.6**

Grade 8

Mathematics Content Standard 4

Students demonstrate understanding of shape and an ability to use geometry.

Benchmark End of Grade 8	GLCE Grade 8	Item Specification Grade 8
1. Identifies, describes, constructs and compares plane and solid geometric figures.	5. Uses geometric relationships (e.g., the Pythagorean Theorem) and properties (e.g., plane, solid) to solve real-world problems.	1. Describe and compare the relationships among geometric figures based on their definitions and properties. **8.4.1.5.1** 2. Constructs a net (pattern) for a common three-dimensional figure. **8.4.1.5.2**
2. Understands and applies geometric properties and relationships (e.g. the Pythagorean theorem).		3. Provides reasons that geometric statements are true and evaluates given reasons. **8.4.2.5.3** 4. Determines similarity of geometric figures. **8.4.2.5.4**
3. Represents geometric figures on a coordinate grid.		5. Makes connections between properties of geometric figures and coordinate geometry, e.g., finding lengths of sides of polygons or coordinates of the midpoints of the sides. **8.4.3.5.5**
4. Explores properties and transformations of geometric figures.		6. Uses or describes the transformation(s) (translation, reflection, and/or rotation) that transform a figure into its image. **8.4.4.5.6** 7. Determines the image of a figure on a coordinate plane after a translation, reflection, or rotation. **8.4.4.5.7** 8. Recognizes the connections between transformations and congruence, line symmetry, and rotational symmetry. **8.4.4.5.8**
5. Uses geometry as a means of describing the physical world.		9. Identifies or draws views (e.g., front, top, right side) of a three-dimensional structure. **8.4.5.5.9**

Grade 8

Mathematics Content Standard 5

Students demonstrate understanding of measurable attributes and an ability to use measurement processes.

Benchmark End of Grade 8	GLCE Grade 8	Item Specification Grade 8
1. Estimates, makes and uses measurements to describe, compare, and/or contrast objects in real-world situations.	6. Uses complex measurement (e.g., units and tools at appropriate level of accuracy, rates and other derived measures) to describe the physical world and solve real-world problems.	1. Estimates the perimeter, area, and volume of irregular regions. **8.5.1.6.1**
2. Selects and uses appropriate units and tools to measure to a level of accuracy required in a particular setting.		2. Selects the best measurement strategy to use relative to the purpose of the measurement and its required accuracy. **8.5.2.6.2** 3. Identifies the possible error in a reported measurement. **8.5.2.6.3**
3. Applies the concepts of perimeter, area, volume and capacity, weight and mass, angle measure, time, and temperature.		4. Uses formulas to determine how a change in side length (radius) or height affects the perimeter (circumference) and area in triangles, parallelograms, and circles, and the volume in rectangular or triangular prisms. **8.5.3.6.4** 5. Solves problems involving the Pythagorean theorem. **8.5.3.6.5**
4. Demonstrates understanding of the structure and use of systems of measurement, including English and metric.		6. Performs conversions among measurements of area and volume, e.g., 1 square centimeter is equal to 100 square millimeters. **8.5.4.6.6** 7. Performs conversions among customary units and among metric units for linear measurements and measurements of capacity and weight. **8.5.4.6.7**
5. Uses the concepts of rates and other derived and indirect measures.		8. Solves problems involving rates and derived measurements, e.g., miles per gallon. **8.5.5.6.8** 9. Solves problems using a scale factor. **8.5.5.6.9** 10. Solves problems involving proportionality and geometric similarity. **8.5.5.6.10**
6. Demonstrates relationships between formulas and procedures for determining area and volume.		11. Uses given formulas to find the circumference of circles and area of rectangles, triangles, parallelograms, trapezoids, and circles as well as the area of figures that can be subdivided into these shapes. **8.5.6.6.11** 12. Uses given formulas to find the

		volume of prisms, cylinders, cones, and pyramids. **8.5.6.6.12** 13. Finds the surface area of prisms and cylinders. **8.5.6.6.13**

Grade 8

Mathematics Content Standard 6

Students demonstrate understanding of and an ability to use data analysis, probability, and statistics.

Benchmark End of Grade 8	GLCE Grade 8	Item Specification Grade 8
1. Systematically collects, organizes, and describes data.	7. Makes reasonable predictions and decisions using data, basic probability, and statistics (e.g., tables, charts, graphs, measures of central tendency), collect, organize, and describe data.	1. Determines appropriate data to collect for a given purpose and how to go about collecting and analyzing those data. **8.6.1.7.1** 2. Selects appropriate graphic representations for data sets. **8.6.1.7.2**
2. Constructs, reads, and interprets tables, charts, and graphs.		3. Interprets and constructs bar graphs, pictographs, line graphs, line plots, stem-and-leaf graphs, circle graphs, frequency charts, histograms, box-and-whisker graphs, and scatter plots. **8.6.2.7.3**
3. Draws inferences, constructs, and evaluates arguments based on data analysis and measures of central tendency.		4. Recognizes how different representations of the same data sets can affect their interpretation. **8.6.3.7.4** 5. Calculates the mean, median, mode, and range of a data set and interprets their meanings relative to the data set. **8.6.3.7.5** 6. Makes judgments regarding the shape and spread of data sets, including consideration of outliers and quartiles. **8.6.3.7.6** 7. Determines how a change in one or more data points affects the mean and median of a data set. **8.6.3.7.7** 8. Draws conclusions and makes inferences and predictions based on data given in charts or graphs. **8.6.3.7.8** 9. Draws lines of best fit on scatter plots and uses them to make predictions. **8.6.3.7.9**
4. Constructs sample spaces and determines the theoretical and experimental probabilities of events.		10. Determines all possible outcomes of an experiment, using a tree diagram, an organized list, or, when appropriate, the fundamental counting principle. **8.6.4.7.10** 11. Finds the theoretical probability of an event in an experiment with equally likely outcomes. **8.6.4.7.11**

		12. Finds theoretical probability involving independent and dependent events. **8.6.4.7.12** 13. Finds the empirical probability of an event, given a set of data. **8.6.4.7.13**
5. Makes predictions based on experimental results or probabilities.		14. Makes predictions based on probability. **8.6.5.7.14**

Grade 8

Mathematics Content Standard 7

Students demonstrate understanding of and an ability to use patterns, relations, and functions.

Benchmark End of Grade 8	GLCE Grade 8	Item Specification Grade 8
1. Describes, extends, analyzes, and creates a variety of patterns and functions.	8. Analyzes and describes functional relationships and their representations (e.g., tables, graphs, verbal rules, algebraic equations).	1. Draws conclusions and makes predictions based on patterns and relationships, both mathematical and from real life. **8.7.1.8.1**
2. Describes and represents relationships with tables, graphs, and rules..		2. Recognizes and creates multiple representations (e.g., words, charts, algebraic expressions or equations, and graphs) of the same linear, real-life situations. **8.7.2.8.2**
3. Analyzes functional relationships to explain how a change in one quantity results in a change in another.		3. Determines in a mathematical or real-life situation involving a constant or variable rate of change how a change in one variable affects the other variable. **8.7.3.8.3**
4. Uses patterns and functions to represent and solve problems.		4. Represents linear and simple, quadratic, exponential real-life situations with algebraic expressions, equations, or inequalities. **8.7.4.8.4**
5. Describes functions using graphical, numerical, physical, algebraic, and verbal models or representations.		5. Matches a situation involving a variable rate of change to a graphic representation that best represents that situation. **8.7.5.8.5** 6. Recognizes relationships represented by tables or graphs as linear or non-linear. **8.7.5.8.6** 7. Writes equations to represent linear graphs. **8.7.5.8.7** 8. Determines the slope and intercepts of a linear equation represented by a graph or an equation and interprets the meaning of those values relative to the context of the problem. **8.7.5.8.8**

Grade 10

Mathematics Content Standard 1

Students engage in the mathematical process of problem solving and reasoning, estimation, communication, connections and applications, and using appropriate technology.

Benchmark Upon Graduation— End of Grade 12	GLCE Grade 10	Item Specification Grade 10
1. Recognizes and formulates problems from situations within and outside mathematics and applies solution strategies to those problems.	1. Selects and uses appropriate processes (e.g., estimation, multiple steps) and technologies (e.g., paper and pencil, calculator, computer, data collection devices) to solve a variety of problems within and outside mathematics and communicates the results. **10.1.1.1** **10.1.2.1** **10.1.3.1** **10.1.4.1** **10.1.5.1** 2. Formulates and communicates logical arguments using appropriate mathematical ideas (e.g. mathematical terms, notations, generalizations) and reasoning. **10.1.1.2** **10.1.2.2** **10.1.3.2** **10.1.4.2** **10.1.5.2**	Standard 1 is embedded throughout the Benchmarks and GLCEs to emphasize the importance of the mathematical processes of problem solving and reasoning, estimation, communication, connections and applications, and using appropriate technology as part of every strand.
2. Selects, applies, and evaluates appropriate estimation strategies throughout the problem-solving process.		
3. Formulates definitions, makes and justifies inferences, expresses generalizations and communicates mathematical ideas and relationships.		
4. Applies and translates among different representations of the same problem situation or of the same mathematical concept. Models connections between problem situations that arise in disciplines other than mathematics.		
5. Selects and uses appropriate technology to enhance mathematical understanding. Appropriate technology may include but is not limited to, paper and pencil, calculator, computer, and data collection devices.		

Grade 10

Mathematics Content Standard 2

Students demonstrate understanding of and an ability to use numbers and operations.

Benchmark Upon Graduation— End of Grade 12	GLCE Grade 10	Item Specification Grade 10
1. Uses and understands the real number system, its operations, notations, and the various subsystems.	3. Uses real and complex number systems to solve mathematical problems.	1. Translates among forms for expressing numbers with large and small magnitudes, including scientific notation. **10.2.1.3.1** 2. Interprets integer exponents and square roots. **10.2.1.3.2** 3. Recognizes and generating equivalent forms of real numbers. **10.2.1.3.3** 4. Orders real numbers. **10.2.1.3.4** 5. Determines numbers belonging to various subsets of the real number system and recognizes the relationships among the subsets, e.g., whole numbers, rational numbers, real numbers. **10.2.1.3.5** 6. Reasons with regard to relationships among whole numbers, e.g., multiples, factors, primes, and divisibility. **10.2.1.3.6** 7. Judges the effects that operations have on real numbers, including operations involving integer exponents and square roots. **10.2.1.3.7** 8. Performing addition, subtraction, multiplication, and division with real numbers. **10.2.1.3.8** 9. Applies the correct order of operations and laws of exponents. **10.2.1.3.9** 10. Solves problems involving ratios, proportions, and percents. **10.2.1.3.10** 11. Estimates based on the operations described above. **10.2.1.3.11**
2. Uses definitions and basic operations of the complex number system.		Not assessed at this grade level.

Grade 10

Mathematics Content Standard 3

Students use algebraic concepts, processes, and language to model and solve a variety of real-world and mathematical problems.

Benchmark Upon Graduation— End of Grade 12	GLCE Grade 10	Item Specification Grade 10
1. Uses algebra to represent patterns of change.	4. Applies functions, graphs, and algebraic concepts to solve real-world problems.	1. Represents rules for real-life and mathematical patterns, both those that can be explicitly defined and those that need to be defined recursively, using words, algebraic expressions, or equations. **10.3.1.4.1**
2. Uses basic operations with algebraic expressions.		2. Evaluates expressions for given values. **10.3.2.4.2** 3. Recognizes and writes equivalent expressions. **10.3.2.4.3**
3. Solves algebraic equations and inequalities: linear, quadratic, exponential, logarithmic, and power.		4. Solves linear equations and inequalities in one variable. **10.3.3.4.4**
4. Solves systems of algebraic equations and inequalities, including use of matrices.		5. Solves two linear equations in two variables algebraically and graphically. **10.3.4.4.5** 6. Solves two linear inequalities in two variables graphically. **10.3.4.4.6**
5. Uses algebraic models to solve mathematical and real-world problems.		7. Represents real-life situations with algebraic expressions, equations, and inequalities, including exponential expressions and equations. **10.3.5.4.7** 8. Draws conclusions and making predictions based on patterns and relationships, both mathematical and from real life. **10.3.5.4.8** 9. Determines the slope and intercepts of a linear equation represented by a graph or an equation and interprets the meaning of those values relative to the context of the problem. **10.3.5.4.9**

Grade 10

Mathematics Content Standard 4

Students demonstrate understanding of shape and an ability to use geometry.

Benchmark Upon Graduation— End of Grade 12	GLCE Grade 10	Item Specification Grade 10
1. Constructs, interprets, and draws three-dimensional objects.	5. Applies geometric relationships (e.g., the Pythagorean Theorem) and properties (e.g., congruence, similarity) to model a variety of problems and situations.	1.Identifies views (e.g., front, top, right side) and cross sections of a three-dimensional structuring. **10.4.1.5.1**
2. Classifies figures in terms of congruence and similarity and applies these relationships.		2. Reasons about properties of classes of two- and three-dimensional geometric figures and the relationships among them. **10.4.2.5.2** 3. Justifies geometric statements through the use of deductive reasoning, particularly statements involving congruence and similarity. **10.4.2.5.3** 4. Recognizes the connections between transformations and congruence, similarity, line symmetry, and rotational symmetry. **10.4.2.5.4** 5. Determines similarity of geometric figures. **10.4.2.5.5**
3. Translates between synthetic and coordinate representations.		6. Analyzes properties of geometric figures using coordinate geometry, e.g., determining lengths of sides using the distance formula and determining whether adjoining sides are parallel or perpendicular using slopes. **10.4.3.5.6**
4. Deduces properties of figures using transformations, coordinates, and vectors in problem solving.		7. Finds counterexamples to disprove false geometric statements. **10.4.4.5.7** 8. Determines the image of a figure on a coordinate plane after a translation, reflection, rotation, or dilation. **10.4.4.5.8** 9. Describes the transformation or transformations (translation, reflection, rotation, and/or dilation) that transform a figure to its image on the coordinate plane. **10.4.4.5.9**
5. Applies trigonometric ratios (sine, cosine and tangent) to problem situations involving triangles.		10. Uses the sine, cosine, and tangent functions to find lengths and angle measures. **10.4.5.5.10**

Grade 10

Mathematics Content Standard 5

Students demonstrate understanding of measurable attributes and an ability to use measurement processes.

Benchmark Upon Graduation— End of Grade 12	GLCE Grade 10	Item Specification Grade 10
1. Applies concepts of indirect measurements (e.g., using similar triangles to calculate distance).	6. Applies complex measurement (e.g., derived measures, indirect measures) to describe and compare and contrast objects in the physical world and solve real-world problems.	1. Uses formulas to determine how a change in side length (radius or diameter) affects the area in triangles, parallelograms, and circles, and the surface area and volume of prisms, cylinders, pyramids, and spheres **10.5.1.6.1** 2. Uses given formulas to find the area of figures that can be subdivided into rectangles, triangles, parallelograms, trapezoids, and/or circles **10.5.1.6.2** 3. Uses given formulas to find the surface area and volume of prisms, cylinders, cones, and pyramids as well as of regions that can be subdivided into these shapes **10.5.1.6.3** 4. Solves problems involving the Pythagorean theorem, proportionality, and geometric similarity **10.5.1.6.4**
2. Uses dimensional analysis to check reasonableness of procedures.		5. Identifies the possible error in a measurement of area or volume **10.5.2.6.5**
3. Investigates systems of derived measures (e.g., km/sec, g/cm^3).		6. Performs conversions among derived units in the customary and metric systems, e.g., converting feet per minute to miles per hour **10.5.3.6.6**
4. Applies the appropriate concepts of estimates in measurements, error in measurement, tolerance, and precision.		7. Selects the best measurement strategy to use relative to the purpose of the measurement and its required accuracy **10.5.4.6.7** 8.Estimates the area or volume of irregular regions **10.5.4.6.8**

Grade 10

Mathematics Content Standard 6

Students demonstrate understanding of and an ability to use data analysis, probability, and statistics.

Benchmark Upon Graduation—End of Grade 12	GLCE Grade 10	Item Specification Grade 10
1. Uses curve fitting to make predictions from data.	7. Makes reasonable predictions and decisions using data, basic probability, and statistics (e.g., tables, graphs, measures of central tendency, variability, correlation, sampling).	1. Draws lines of best fit on scatter plots and uses them to make predictions. **10.6.1.7.1**
2. Applies measures of central tendency and demonstrates understanding of the concepts of variability and correlation.		2. Calculates the mean, median, mode, and range of a data set and interprets their meanings relative to the data set. **10.6.2.7.2** 3. Makes judgments regarding the shape and spread of data sets, including consideration of outliers and quartiles. **10.6.2.7.3** 4. Determines how a change in one or more data points in data sets affects statistics of the sets. **10.6.2.7.4**
3. Selects an appropriate sampling method for a given statistical analysis.		5. Designs experiments and surveys. **10.6.3.7.5**
4. Uses experimental probability, theoretical probability and simulation methods to represent and solve problems, including expected values.		6. Determines all possible outcomes for an experiment, using a tree diagram, an organized list, or, when appropriate, the fundamental counting principle. **10.6.4.7.6** 7. Finds theoretical probability involving independent and dependent events. **10.6.4.7.7** 8. Finds the empirical probability of an event, given a set of data. **10.6.4.7.8** 9. Makes predictions based on probability. **10.6.4.7.9**
5. Designs a statistical experiment to study a problem and communicate the outcomes.		10. Selects appropriate graphic representations for data sets. **10.6.5.7.10** 11. Interprets and constructs bar graphs, pictographs, line graphs, line plots, stem-and-leaf graphs, circle graphs, frequency charts, histograms, box-and-whisker graphs, and scatter plots. **10.6.5.7.11** 12. Recognizes how different representations of the same data sets can affect their interpretation. **10.6.5.7.12** 13. Draws conclusions and makes

		inferences and predictions based on data given in charts and graphs. **10.6.5.7.13**
6. Describes, in general terms, the normal curve and uses its properties to answer questions about sets of data that are assumed to be normally distributed.		Not assessed at this grade level.

Grade 10

Mathematics Content Standard 7

Students demonstrate understanding of and an ability to use patterns, relations, and functions.

Benchmark Upon Graduation— End of Grade 12	GLCE Grade 10	Item Specification Grade 10
1. Describes functions and their inverses using graphical, numerical, physical, algebraic and verbal mathematical models or representations.	8. Analyzes functions using graphical, numerical, and algebraic methods.	1. Recognizes functions represented by verbal descriptions, equations, tables, or graphs as linear, non-linear, or exponential. **10.7.1.8.1** 2. Graphs linear equations and writing equations that represent linear graphs. **10.7.1.8.2** 3. Graphs linear inequalities. **10.7.1.8.3**
2. Analyzes the graphs of the families of polynomial, rational, power, exponential, logarithmic, and periodic functions.		4. Analyzes various types of functions with regard to change, e.g., step functions, continuous linear functions, exponential functions, functions that increase (decrease), or do so over certain intervals. **10.7.2.8.4**
3. Analyzes the effects of parameter changes on the graphs of functions and relations, including translations.		5. Determines in a mathematical or real-life situation involving a constant or variable rate of change how a change in one variable affects the other variable. **10.7.3.8.5**
4. Models real-world phenomena with a variety of functions.		6. Recognizes and creates multiple representations (e.g., words, charts, algebraic expression or equations, and graphs) of the same linear, real-life situations. **10.7.4.8.6**
5. Uses graphing for parametric equations, three-dimensional equations, and recursive relations.		Not assessed at this grade level.